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Measuring Health Care Micro-Economic Efficiency: A Case Study of Massachusetts Hospital's Quality and Value Measurement with Risk Adjustments

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MEASURING HEALTH CARE MICRO-ECONOMIC EFFICIENCY: A CASE STUDY OF MASSACHSETTS HOSPITAL'S QUALITY AND VALUE MEASUREMENT WITH RISK ADJUSTMENTS

An internship report submitted in partial fulfillment
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I HEREBY RECOMMEND THAT THE INTERNSHIP REPORT PREPARED UNDER MY SUPERVISION BY Yanling Zhang ENTITLED Measuring Health Care Microeconomic Efficiency: A Case Study of Massachusetts Hospital's Quality and Value Measurement with Adjustment BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science.

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ABSTRACT

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This report has four main parts: 1) Introduction: The healthcare phenomenon, considerations and economic implications; 2) A case study of measuring health care quality and value for methodology investigation; 3) conclusions and 4) policy implications. The principal aim of this report is to discuss methods of measuring micro-economic efficiency in healthcare. In the introduction, economic theories including elasticity, demand and supply, competition, market failure and so on are applied to healthcare. Next the role of this report is placed within the context of organization I worked for with a case study to show how to measure quality and value with risk adjustment related to the issues raised in the introduction. Conclusions are drawn from the case study, and limitations and other issues are raised for further study. The final section discusses policy implications. At the end of the report, reference articles and books are listed. And an appendix with the sample SAS (Statistical Analysis System) programming and outputs written and generated during the intern research period are also attached.

This internship was performed at CareGroup, an organized system of quality healthcare serving the individual, family, and community, which includes teaching hospitals for Harvard Medical School, located at Boston, Massachusetts.

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I. Introduction: Health Care Phenomenon, Consideration and Economic Implication

More than ever, we feel a sense of urgency to improve health care quality and value. Efficiency problems have significant economic implications and prompted this urgency. Health care is unlike most consumer goods. When you go shopping, you usually can compare the quality and price and then buy the one either with better quality or with lower price according to your preference. However, when you are sick and need to visit a doctor, it seems that you have no choice or you never think about making choices. You just make an appointment to visit your primary-care physician. The vast majority of patients lack the information necessary for informed choice. This information failure is one of the characteristics of the health market. This information failure is one of the characteristics of the health market. Hence, patients are compelled to delegate, to varying degrees, treatment decisions to medical professionals who also supply the services demanded –creating a potential conflict of interest. Even within the medical profession, there are pervasive uncertainties about treatment options and consequences. For example, an experienced doctor is used to prescribing the medicine with which he/she is familiar when faced with a patient with a certain diagnosis, although there are many newly released medicines of lessor prices and maybe more effective. Another example is that an emergency doctor trained from a certain medical school is taught to do a radiology scan on the patients who came to the emergency room with a complaint of ankle pain. This

may be justified, but it inevitably causes higher costs to those who do not have ankle fractures. This suggests considerable variability in accepted medical practice.

Another issue we need to consider is the problem of moral hazard. On the demand side, this may be reflected in an increase in the demand for covered health care because patients do not face the full marginal cost. But moral hazard is not limited to demand. On the supply side, for example, the incentive to over-supply medical services may be heightened when a third party (insurance company) pays the bulk of any services that doctors choose to provide. These effects may be strongest under fee-for-service payment arrangements.

These are the efficiency issues. In health care, microeconomic efficiency emphasizes that quality of care and consumer satisfaction should be maximized at minimum cost. Micro-efficiency has two aspects: productive efficiency associated with producing a fixed set of services at minimum cost; and effectiveness, defined as maximizing services provided for a fixed set of inputs or maximizing the impact on health goals, defined as the length and quality of life. Costs ought to include administrative expenses. Micro-efficiency also requires taking into account "spill-over" effects (e.g., due to communicable diseases and productivity-related effects on the labor force). Dynamic efficiency considerations include searching for organizational forms and technological advances that improve the productivity of health resources. More broadly, in assessing the most efficient ways to improve health "outcomes"(or health status), governments need to consider whether increased resources channeled into mainstream health services are not draining resources

from other, more effective, programs. These could include, for example, housing, education, income maintenance, and nutrition and hygiene programs, all of which could influence the population's health[1]. Alain Enthoven (1988) makes this point nicely, writing, " An efficient allocation of health care resources to and within the health care sector is one that minimizes the social cost of illness, including its treatment. This is achieved when the marginal dollar spent on health care produces the same value to society as the marginal dollar spent on education, defense, personal consumption, and other uses. Relevant costs include the suffering and inconvenience of patients, as well as the resources used in producing health care. This goal should not be confused with minimizing or containing health care expenditures. Policy makers focus much attention on the total amount of spending on health care services, often as a share of gross national product (GNP). But, a lower percentage of GNP spent on health care does not necessarily mean greater efficiency. If the reduced share of GNP is achieved by denial or postponement of services that consumers would value at more than their marginal cost, then efficiency is not achieved or enhanced by the cut in spending"(p. 11).[2]

From hospital perspective, they are faced with an environment of growing competition, changing payment mechanisms, and consolidation. These factors and others challenge hospital executives to respond with better quality and value management. Hospitals face growing challenges to maintain or expand their share of a decreasing market by achieving these capabilities. By not responding to the changes, they risk their very survival to an

[1] Howard Oxley and Maitland MacFarlan:"Health Care Reform Controlling Spending and Increasing Efficiency".

acquisition or merger. Hospitals also have objectives common to other businesses. For example, they must remain profitable in order to serve their communities effectively and to embrace capital markets for plant and technology modernization. The services they deliver must be of high quality to attract and retain customers in a competitive marketplace. Finally, they have significant human resource and management systems issues to address.

Given these changes, it is more critical than ever for hospitals to examine their environment -- today and projected into the future -- and to plan courses of action to ensure their survival. For some hospitals, the competitive marketplace has caused major problems. Their ability to react has been severely constrained by antiquated management structures and information systems. This has forced them into a position of reaction instead of proaction --making it difficult for them to improve their market, operational, or financial position. However, a growing number of hospitals are taking aggressive and innovative postures in the health care marketplace. These hospitals are developing effective management and information structures to secure their positions, today and tomorrow. A key feature of these new management and information structures is an enhanced ability to manage hospital costs.

Before the Medicare Prospective Payment System (PPS) and the influx of fixed-price payment schemes, hospitals were more concerned with increasing revenues. Since many insurers paid published charges and Medicare reimbursed hospitals based on costs, the

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[2] Thomas Rice: "The Economics of Health Reconsidered".

cost of operations was of secondary concern. However, in order to retain or increase their profitability levels today, providers need to focus on the cost of operations to manage their profitability--revenue and cost of operations. The key issue here is the quality measurement and reporting. In the March 1998 report to the President, the Advisory Commission on Consumer Protection and Quality in the Health Care Industry noted that substantial work is required to develop and refine measures of health care quality. In Chapter 4 "Advancing Quality Measurement and Reporting" of part II "Establishing Health Care Quality as a National Priority", the report pointed that:" Establishing national aims for improvement alone will not lead to better quality health care. Standardized measures of quality are needed to track the health-care industry's progress in reaching the aims established for the Nation and to guide public health planning and policy making. Comparative information on quality also is needed for individual consumers, group purchasers, and others to use in selecting health care providers and health plans. Furthermore, valid and stable quality measures are integral to health plans' and providers' efforts to improve performance, and, when standardized, encourage health care organizations to learn from each other through a process of benchmarking.

Despite a growing number of efforts to measure and report on health-care quality, useful information is neither uniformly nor widely available. Improving our ability to measure quality has been the object of significant public and private sector activity over the last decade, reflecting the expectation that measurement can serve both as a catalyst and a tool for improvement. While considerable advancements have been made in the quality-measurement field in recent years, current efforts fall short of fully meeting users' needs,

and often are duplicative and unduly burdensome on health care providers, plans, and others.[3] At CareGroup Center for Quality and Value, we are conducting path-breaking research to devise new and creative quality measures and cost management. In another words, we are measuring health care microeconomic efficiency. Hospitals are experiencing financial difficulties; insurance companies are losing money; doctors are complaining the insurance companies are controlling too much of the freedom of care they provide to patients. Patients are complaining that there are not enough spending on them. Where does all the money go? What is the bottleneck to prevent from efficiency? Efficiency is hard to measure.

The principal aim of this paper is to discuss microeconomic efficiency using a method that measures the spending with risk adjustment for the managed care population for CareGroup hospitals in the physician performance measurement profile project. These projects involve investigation of methods to improve health-care quality and value. These methods will have a significant impact on health-care policy making and improvement. Thus, they will also have impact on the economy since health care is a large part of our economy.

[3] http://www.hcqualitycommission.gov/final/chap04.html

II. Case Study of Measuring Health Care Quality and Value

Physician Performance Profile with Risk adjustment

Goals

The purpose of this profile is to develop a set of provider profiles for physicians throughout the CareGroup health care network. These profiles will be used to guide the behavior of clinicians and the decisions of practice groups, to identify and promote the use of best practices. In order to achieve meaningful comparisons of outcomes across groups of patients, I will perform risk adjustment using the Diagnostic Cost Groups-Hierarchical Condition Category (DCG-HCC) methodology on assessments of resource consumption and relative resource needs of patients across CareGroup's risk units for CareGroup and Primary Care Physicians of Provider Service Network (PSN).

Background

Comparing outcomes is now central to changing the American health care delivery system and responding to competitive market forces. Patients' outcomes are compared across hospitals, groups of doctors (e.g., group practices, multi-specialty clinics), individual doctors, or health plans (e.g., health maintenance organizations, managed care companies). The comparisons are variously called performance or practice profiles, report cards, scorecards, and outcomes reports. As Dr. Dennis S. O'Leary, 1993 President of Joint Commission on Accreditation of Health Care Organizations said, "Report card day is

coming in the health care world". Methods for producing profiles generate considerable controversy and raise numerous challenging conceptual and statistical questions.[4] Different hospitals and doctors see different types of patients. Many factors produce these differences, ranging from patients' individual health needs (e.g., acuity and severity of illness) to financial considerations to geographic location to patients' preferences and expectations. These differences have consequences. Most importantly, patients with complex illnesses, multiple coexisting diseases, significant disabilities, and other important risk factors are generally more costly and likely to do poorly, even with the best care, than healthy persons. Patients' outcomes and resource needs vary, sometimes widely, across doctors and hospitals.

For examining resource consumption (e.g., use of captivated dollars), risk adjustment aims to account for the higher costs of treating sick and disabled patients. Here, "risk" relates to expected costs for a period of care, and "risk adjustment" means adjusting assessments of resource use to reflect different levels of risk. For example, risk adjustment recognizes that patients with lung cancer typically generate higher costs than do patients with hypertension. Adjusting for the financial risks posed by varying health status should make physicians and hospitals more willing to accept chronically ill persons, fostering high-quality care across the spectrum of disease and disability.

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[4] Goldfield, N. and P. Boland, Eds. 1996 "*Physician Profiling and Risk Adjustment*" Gaithersburg, MD: Aspen Publishers, Inc.

For performance measurement, risk adjustment assumes that outcomes result from complex interactions among various treatments, patient characteristics affecting response to treatment, physician characteristics, quality of care, and random chance. Risk adjustment controls for intrinsic patient characteristics, facilitating judgments about relative quality when comparing outcomes across providers. Thus, residual differences in patient outcomes across providers may reflect quality.

Methods for Risk Adjustment to Compare Cost Utilization

In most profiles, utilization and expenditure are compared among risk units or physicians. However, sicker patients tend to consume more resources than healthy patients who only have physical examinations each year. Many health plans, including Medicare, adjust for risk using primarily age and sex. Age and sex adjustment alone, however, explains only about 1% of differences in annual resource consumption across patients.

Efforts to adjust risk using more clinical information are hampered by limitations of available information. Clinical data on disease severity and patients' physical functioning are not available. Therefore, the only current option for risk adjustment across panels of patients uses diagnostic data from claims and encounter records submitted by physicians and hospitals. While several methods exist for diagnosis-based risk adjustment, one of the leaders is the Diagnostic Cost Groups (DCGs). A version of the DCGs, the Principal In-Patient DCGs (or PIP-DCGs) has been selected by the Health Care Financing

Administration (HCFA) as the method they will implement for risk adjusting Medicare capitation payments starting January 1, 2000.

Description of the DCGs

The Diagnostic Cost Groups Hierarchical Condition Categories (DCGs-HCCs) are among several models for predicting future costs first developed under contract to HCFA by investigators at Boston and Brandeis Universities in the mid-1980s. Early DCG methods were hampered by using only inpatient Medicare claims, such as the PIP-DCGs mentioned above. Afterwards, the DCGs-HCCs were created, using ambulatory and inpatient encounter records for Medicare beneficiaries. Developers used three data sets: a commercial database representing 1.4 million persons with private insurance indemnity and HMO records from 200,000 Massachusetts state employees, and data on 1 million Michigan Medicaid recipients.

For the CareGroup analyses, we use a version of the DCGs-HCCs developed explicitly for working-age adults and families. To derive the DCGs-HCCs, we need to feed in 2 final big datasets, the diagnosis file and persons file. First the diagnosis file is derived from the claims data from 3 payers (Blue Cross Blue Shield, Harvard Pilgrim Health Care and Tufts Health Plan). The persons file is from the eligibility tables from the above-mentioned payers. The DxCG software designed by the DxCG company will use the 2 main files we input and the macro derived from the regression model to assign diagnosis codes to 543 mutually exclusive "diagnostic groups," aiming to create clinically coherent categories with

adequate sample sizes. Based on regression analyses and clinical judgment, these "diagnostic groups" collapsed into 136 condition categories, which are then used to predict expected costs. Hierarchies within conditions aim to prevent additional diagnoses, within related conditions, from adding to cost predictions. Thus, the DCG-HCCs assign each person a "risk score" based on the combined effect of age, sex, and all diagnoses reported within the last year on inpatient and outpatient claims. "Risk scores" indicate the predicted costliness of people compared to a CareGroup sample population average of 1.0. For example, a "risk score" of 1.5 indicates 50% higher predicted costs than average. To examine the "risk" associated with a particular hospital or physician group, the risk scores across all patients for that provider are added, then divided by the number of patients. This produces an average risk score that can be compared to average scores for other groups.

Models and Variants: The DxCG program implements three DCG regression model variants distinguished by the information used to make predictions and the way in which the information is used:

Age-sex models use age and sex demographic information only. These models use more traditional measures of risk assessment and are meant to serve as a base line to the other DCG models for comparative purposes.

PIPDCG models use age, sex and principal inpatient or "PIP" diagnoses to classify an individual according to the single most significant medical problem detected. "Most significant" means having the highest future cost implications. Secondary diagnosis codes appearing on impatient claims are not used in these models as are diagnoses appearing on

physician and outpatient claims. PIPDCG models are fully hierarchical, single-condition models.

DCG/HCC models use age, sex and all diagnoses --both inpatient and outpatient --recorded on claims involving contact with clinically trained medical providers. Hierarchical Condition Categories (HCCs) are groupings of diagnostic codes based on clinical condition and expected resource. Hierarchies are imposed to assure that each individual receives credit for only the most costly of related condition categories. DCG/HCC models are multiple-condition models meaning that they recognize the cumulative effect of multiple problems.

According to numerous tests, both DCG/HCC and PIPDCG models predict annual resource use much better than age/sex models. In general, DCG/HCC models have higher predictive power than PIPDCG models. However, PIPDCG models have the advantage of significantly simpler data requirements (only inpatient hospital bills are required) and are generally less sensitive to diagnostic coding completeness than DCG/HCC models.

Required data input files consist of two files: The Diagnosis Input File contains all International Classification of Diseases 9th Revision Clinical Modification (ICD-9-CM) diagnoses, Current Procedural Terminology 4th revision (CPT-4) procedure codes, and expenditures recorded on "at-risk" claims from the managed-care claims files. Each of these quantities is associated with a unique enrollee. The Enrollment Input File contains age, sex, primary care physician and provider unit for all eligibles.

Time Periods: DCG models use information from the base year, or "Year 1", to generate predictions of resource use for two different one-year time periods: Prospective models use Year 1 diagnoses to predict Year 2 expenditures. They are sometimes called "payment" models because they can be used to set payment levels (capitation rates) on a prospective basis. Prospective DCG models emphasize measuring future expenditures resulting from chronic illness. They are particularly useful in measuring the extent of chronic illness burdens among enrollees in a health plan or patients treated by a group of providers.

Concurrent models use Year 1 diagnoses to predict Year 1 expenditures. They are sometimes called "retrospective" or "profiling" models in that they offer a complete profile of the diagnoses receiving treatment within a population. They are often used to profile providers. Concurrent models predict better than prospective models because the same patient generates diagnosis codes in Year 1, simultaneously generate costs in Year 1.

Due to their greater explanatory power, concurrent models are more suitable for predicting expenditures for small groups of enrollees or patients, or when measuring acute health status. For example, concurrent models are useful when acute-care patients are triaged among providers according to severity of illness. In the CareGroup context, since we do not have enough claims data, we only use nine months of claims data for 1998.

Data populations: DCG models have been developed for three populations, reflecting the three major types of health insurance coverage in the United States:

The **Medicare** population, includes the aged (age 65 and over) and disabled (under age 65), and dual Medicare/Medicaid eligibles, but excluding End Stage Renal Disease enrollees.

The **Medicaid** population, includes children, pregnant women, disabled (SSI) and medically needy, but excluding Medicaid enrollees age 65 and over. The **Commercial**, privately insured under-age-65 population includes both children and adults. This population includes enrollees of Commercial insurance plans, Blue Cross; Blue Shield Plans, PPOs and self-insured employer sponsored plans.

Research Progress to Date

We use the DCG-HCC methodology to examine resource consumption across "risk units"(hospitals) within CareGroup. We applied the DCG-HCC methodology to 1998 data from capitated Blue Cross/Blue Shield (BCBS) and Harvard Pilgrim Health Care (HPHC) and 1997 and 1998 data from the Tufts Health Plan. These analyses demonstrate that we can successfully apply the DCG-HCC approach to our insurance claims data and produce meaningful information. Several analyses have been done for Tufts, HPHC and Blue Cross payers stratified by time period of a half year, 9 months for 1998 current data (about 9 months), Jan.-June 98 and Tufts 1997 (12 months), and found that the risk scores do change as more claims add on. Compared with the first half year, BC seems have sicker patients, however, add the recent 3 months' claims data, Tufts' risk scores are higher than BC. Plus, the DxCG program is designed to require 12 months of claims data with payers updating their data daily. The decision to which payer have sicker patients should not be made before reviewing one year's data. The analyses results do show that different providers within CareGroup had very different risk profiles based on the DCG-HCC risk assessments. The PSN leadership found that DCG-HCC-based assessments

about especially efficient versus inefficient risk units meet their prior expectations. We are applying these risk measurements to produce provider profiles, focus case management efforts, and refine disease-management projects.

The lengths of eligibility time are also tested for sensitivity purposes. Although they are designed to be sensitive at each individual level to determine the risk score, they are not designed to be sensitive if everyone has the same length of eligible time at risk at unit level. The program is required to default into 12 months, however using 6 or 9 months make no difference in the results of the risk scores for risk units when we use the snapshot eligibility tables and the eligible-months variable is not available. Later, when we created the eligible months from the historical eligibility tables, we learned that the risk scores are sensitive and should be weighted by the eligible months. For example, when you want to compare two doctors' patient's severity characteristics, the following formula is used to calculate each doctor's patients' risk score:

The doctor's risk score=[sum of (patients' risk score* eligible months)]/[sum of eligible months] .

Thus, the number of eligible patients and their number and degree of claims and also their eligible length of time determine the risk scores either by patients or by primary care physician or by risk units.

After all kinds of data cleaning and sensitivity testing, we performed several tests running the DCG-HCC model with the 3 payer's input files respectively. We decided to combine the 3 payers for our CareGroup context as whole using the merged 1998-9 months claims

data and do the analyses by risk units and doctors for mainly three purposes: Physician performance profile risk adjustment for quality and cost improvement; case management; and disease management.

Key Findings and Application

Since the model can assign each patient a predicted risk score according to their age, sex and all claims of diagnosis and cost, the risk scores can help us to identify persons who will consume considerable resources in the future. This is essential to: (1) devising ways to rationalize and coordinate that care, presumably to improve overall quality; and (2) determining whether, in fact, expenditures could be reduced by better managing that care.

Predicting costly patients is hampered by the apparent randomness of many health care expenses: given a large population of patients, even the best statistical models could probably predict only about 25% of cost variations, due largely to the randomness of future resource needs. For example, one might be healthy today, generating few costs, but develop leukemia next year, precipitating high costs. There is virtually no way to predict exactly who will develop that leukemia.

Thus the hospital policy makers would like to see the risk adjusted profile for each hospital within CareGroup so that they can reallocate the resources. (See Appendix for detail). The report by hospital shows that the risk of medical expenditures differs substantially across CareGroup hospitals, indicating the need for risk adjustment. For

several hospitals, the diagnosis-based score differs significantly from the age/sex score, showing the value of diagnosis-based risk adjustment. The report presents the hospital policy makers the following information:

A. summary distribution of individuals and relative risk scores by hospitals;
B. distribution of individuals by age-sex groups and hospitals;
C. distribution of individuals by aggregated condition categories and hospitals;
D. distribution of individuals by condition categories and hospitals;
E. actual expenditures, predicted expenditures and efficiency indices by hospitals;
F. distribution of individual by diagnostic cost group.

After determining the risk score for each patient, we can also calculate the risk scores by the patients' primary care physician (PCP) to get the PCP's average risk score. In order to encourage doctors to accept sicker patients, who tend to utilize more resources, certain economic subsidies should be considered by the hospitals and payers according to the PCP's average risk scores. The scores can also be calculated by risk unit to get the average risk score in order to look at which hospital tends to attract sicker patients and which performed efficiently based on diagnoses and allocated.

We use the results to put in the physician's report cards for them to fully understand their patients and disease in order for them to provide more efficient and effective care. Here is the example we will deliver to the primary care physicians:

Figure 2.1: Report Card Example:

Report Card for Dr. XXXXXXXXX, License Number: 12435
Group: Health Care Associates
Risk Unit: BIDPO
Pod: 6

Summary:
Your panel size is 586 as compared with a BIDPO average of 407 and PSN Average Panel Size of 352. On average, based on the diagnosis risk adjustment, the patients in your panel are predicted to be 3.2 times more costly than the average PSN panel. Your total costs were 130.52 per member per month as compared to a BIDPO average of 121.37 and a PSN average of 105.00 per member per month. Your average billing level is 3.2 as compared with a PSN average of 2.7.

Your patient management:
We have analyzed the claims experience of your panel over the last year and have identified the most severally ill patients in your panel based on diagnosis and not on utilization. The top ten high-risk patients in your panel and the diagnoses are as follows:

FIRST_NAME	LAST_NAME	Diagnosis Condition Category	1998 Risk Score	Total Cost
KENNETH	XXXXXXXXX	Other Dermatological	15.41	$1,181
		Moderate Cost Neurological		
		Minor Symptoms, Signs, Findings		
		Iron Deficiency and Other Anemias		
		Blood/Immune Disorders		
		Low Cost Gastrointestinal		
		Other Infectious Disease		
		Major Symptoms		
		HIV/AIDS		
URSULA	XXXXXXXXX	Minor Symptoms, Signs, Findings	12.85	$678
		History of Disease		
		Other Endocrine, Metabolic, Nutritional		
		Benign Neoplasm		
		Other Musculoskeletal/Connective Tiss		
		Other Lung Disease		
		Other Urinary System		
		Renal Failure		
DONALD	XXXXXXXXX	High Cost Neurological	9.07	$9,125
		Major Symptoms		
		Moderate Cost Gastrointestinal		
		Benign Neoplasm		
		Low Cost Cancers/Tumors		
		Other Musculoskeletal/Connective Tiss		
		Low Cost Gastrointestinal		

		Iron Deficiency and Other Anemias		
		Moderate Cost Neurological		
		Minor Symptoms, Signs, Findings		
		Other Infectious Disease		
		Other Endocrine, Metabolic, Nutritional		
PAUL	XXXXXXXXX	Valvular and Rheumatic Heart Disease	7.88	$1,847
		Moderate Cost Congenital		
		Screening/Observation/Special Exams		
		Other Mental and Substance Abuse		
		Other Musculoskeletal/Connective Tiss		
		High Cost Eye		
		Low Cost Genital		
		Other Endocrine, Metabolic, Nutritional		
		Other Infectious Disease		
		Congestive Heart Failure		
		Low Cost Gastrointestinal		
EDWARD B	XXXXXXXXX	Minor Symptoms, Signs, Findings	6.91	$7,660
		Major Symptoms		
		Other Dermatological		
		Other Urinary System		
		High Cost Acute Gastrointestinal		
		Other Heart Diagnoses		
		Screening/Observation/Special Exams		
		Low Cost Gastrointestinal		
		Moderate Cost Gastrointestinal		
		High Cost Ear, Nose, and Throat		
ERNST	XXXXXXXXX	High Cost Cancer	6.38	$73
ROBERT	XXXXXXXXX	Low Cost Pneumonia	6.22	$24,445
		Moderate Cost Cancer		
		Major Symptoms		
		Low Cost Cancers/Tumors		
		Low Cost Ear, Nose, and Throat		
		Other Infectious Disease		
		Other Injuries and Poisonings		
		Low Cost Gastrointestinal		
		Iron Deficiency and Other Anemias		
		Minor Symptoms, Signs, Findings		
LINDA	XXXXXXXXX	Other Musculoskeletal/Connective Tiss	5.24	$1,307
		Benign Neoplasm		
		Other Urinary System		
		Low Cost Ear, Nose, and Throat		
		High Cost Neurological		

		Asthma		
		Screening/Observation/Special Exams		
MARILYN	XXXXXXXXX	Moderate Cost Cancer	4.53	$1,873
		Other Dermatological		
		Other Heart Diagnoses		
		Benign Neoplasm		
		Other Infectious Disease		
		Uncertain Neoplasm		
		History of Disease		
		Screening/Observation/Special Exams		
		Minor Symptoms, Signs, Findings		
KATHY	XXXXXXXXX	Low Cost Genital	4.42	$1,475
		History of Disease		
		Low Cost Cerebrovascular Disease		
		Other Musculoskeletal/Connective Tiss		
		Other Endocrine, Metabolic, Nutritional		
		Minor Symptoms, Signs, Findings		
		Low Cost Cancers/Tumors		
		Low Cost Neurological		
		Screening/Observation/Special Exams		
JAMES	XXXXXXXXX	Chronic Ischemic Heart Disease	4.36	$590
		Atherosclerosis		
		Major Symptoms		
		Other Musculoskeletal/Connective Tiss		
		Other Endocrine, Metabolic, Nutritional		
		Other Injuries and Poisonings		

For your disease management:

We have analyzed the claims experience of your panel over the last year and have identified the disease states which most likely to cause the greatest utilization in your panel. The following 10 disease states most severe and likely to cause utilization in your panel are:

Diagnosis Condition Category	Average Risk Score	# of Patients
HIV/AIDS	15.41	1
Renal Failure	12.85	1
Blood/Immune Disorders	9.55	2
Iron Deficiency and Other Anemias	7.94	4
Moderate Cost Congenital	7.88	1
Congestive Heart Failure	7.88	1
High Cost Neurological	7.16	2
Moderate Cost Neurological	7.08	4
High Cost Acute Gastrointestinal	6.91	1
High Cost Cancer	6.38	1

Your utilization:

Based on the severity of illness of your patients, we have computed the predicted costs of managing your panel (mean CareGroup expense per patient/relative risk of your patients). Your predicted costs were 120.27 per member per month, while your actual costs were 130.52. Thus your patients are utilizing 8% more services than expected, after adjusting for illness severity. Your utilization per member per month by category is as follows:

	Your Practice	BIDPO	PSN
Radiology	$8.00	$10.00	$9.00
Laboratory	$3.00	$4.00	$3.50
Pharmacy	$15.00	$12.00	$11.00
Office Visits	$5.00	$4.00	$5.00
Inpatient Hospitalization	$20.00	$25.00	$22.00

The above report card will not only help physicians have an overall picture of their patients and utilization but also help them organize their care to be more efficient and effective. Because when doctors have increased patient loads, it will be hard for them to keep track of each of them. Another advantage is that knowing about disease management helps them to choose in early intervention or prevention to avoid later greater cost. The report card can also help the hospital and payer executive to subsidize the doctors who see sicker patients and suffer from economic losses. Some doctors tend to argue that their patients are sicker before the risk adjustment explains their inefficiency. The risk adjustment based on their own patients' diagnosis and demographic information will clarify those misunderstanding and help them to perform more efficiently.

Since CareGroup is an integrated healthcare delivery systems including eight hospitals (or called risk units) because each hospital bears the risks itself, comparison among these eight hospitals and efficient relocation of resources becomes very important for the

administrators. From the DxCG model, a summarized tables for each risk units' risk score can be assigned to see which hospital have sicker patients:

Table 2.1: Summary Comparisons Using DCG3 Model On the Full Sample Frequencies and Means for Benchmark & Current Sample

	Bench mark	Total	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8
		Distribution of Individuals								
Eligible years (Year 2)	1,379,023	195,778	13,488	61,575	32,226	11,662	9,699	6,351	56,628	4,149
Percent of Sample	100.0	100.0	6.9	31.5	16.5	6.0	5.0	3.2	28.9	2.1
		Relative Risk Scores								
		Normalized to Benchmark Sample								
Age/Sex Model	1.00	1.02	0.33	1.21	1.04	0.79	1.04	1.05	0.99	1.21
Concurrent (Year 1) 1998	1.00	1.10	0.65	1.29	1.05	0.94	1.20	1.16	1.00	1.50
Prospective (Year 2) 1999	1.00	1.11	0.37	1.40	1.08	0.80	1.16	1.19	1.01	1.38
		Relative Risk Scores								
		Normalized to Current Sample								
Age/Sex Model		1.00	0.33	1.19	1.02	0.77	1.02	1.03	0.97	1.19
Concurrent (Year 1) 1998		1.00	0.59	1.18	0.95	0.86	1.10	1.06	0.91	1.37
Prospective (Year 2) 1999		1.00	0.33	1.26	0.98	0.72	1.04	1.07	0.91	1.25

The above table shows each hospital's numbers of patients for 1998 and consists of the percent of overall CareGroup sample size. It also shows three different relative risk scores generated from the DxCG models- age/sex model, diagnostic cost group concurrent predict model and diagnostic cost group prospective predict model with comparison with national benchmark and normalized to CareGroup sample size. From the above table, we can see that RU2 hospital has the biggest population size among all the hospitals. CareGroup overall has a sicker population than the national benchmark population. Among CareGroup hospitals, RU8 has the sickest population, which may result in more resource utilization.

Demographics sometimes are correlated with the risks:

Table 2.2: Summary of Age and Sex

	Benchmark	Total	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8
All Eligibles	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Female	52.9	53.5	48.1	56.0	53.8	52.6	49.4	44.8	53.8	55.3
Male	47.1	46.5	51.9	44.0	46.2	47.4	50.6	55.2	46.2	44.7
Child: Age 0 to 17	26.7	21.9	92.6	2.6	19.6	47.9	19.7	13.9	24.8	2.7
Young Adult: Age 18 to 44	45.0	49.9	7.3	61.3	51.3	33.2	48.5	57.1	48.8	59.6
Older Adult: Age 45 to 64	28.3	26.6	0.0	34.2	27.6	17.5	30.5	27.3	24.6	35.6
Senior: Age 65+	0.0	1.6	0.0	1.8	1.5	1.4	1.2	1.8	1.9	2.0
Mean Age	31.8	33.1	8.7	39.8	33.8	24.3	34.5	35.4	32.1	40.0

RU8 hospital has the highest mean age and an older population, which is positively, correlated with its highest relative risk score. On the other hand, RU1, which is a children's hospital, has the youngest population and also has relatively low risk scores.

In order for the whole CareGroup to efficiently re-allocate resources, determining which hospital attracts what kinds of patients is the key. The following Diagnostic profile will help achieve this goal:

Table 2.3: Number of Individuals by Aggregated Condition Category (ACC)

Aggregated Condition Category (ACC)	Total	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8
All Eligibles	195,776	13,488	61,575	32,226	11,662	9,699	6,351	56,628	4,149
No Claims or Valid Diagnosis in Sample	47,298	2,715	15,012	9,682	2,020	2,115	1,705	13,063	986
01: Infectious and Parasitic	16,190	2,076	4,296	1,847	1,532	681	517	4,969	272
02: Malignant Neoplasm	3,156	23	1,449	454	120	139	84	804	83
03: Benign/In Situ/Uncertain Neoplasm	14,503	267	5,980	1,811	790	774	430	4,092	359
04: Diabetes	4,896	29	2,225	834	120	218	237	1,105	128
05: Nutritional, and	19,162	154	8,191	2,993	976	1,118	681	4,275	774

Metabolic.									
06: Gastrointestinal	17,336	618	6,291	2,994	986	804	670	4,457	516
07: Musculoskeletal and Connective Tiss.	28,620	603	10,315	4,619	1,307	1,634	1,033	8,155	954
08: Hematological	3,990	89	1,493	594	274	193	205	944	198
09: Mental	7,902	392	2,279	1,456	461	573	329	2,210	202
10: Mental Retardation	17	2	2	3	4	0	1	5	0
11: Neurological	6,649	176	2,379	999	348	427	205	1,912	203
12: Cardio-Respiratory Arrest	290	9	97	38	20	16	12	85	13
13: Heart	18,460	80	7,526	3,250	665	992	664	4,625	658
14: Cerebro-Vascular	632	11	209	115	33	35	14	200	15
15: Vascular	2,739	39	1,018	472	155	123	131	722	79
16: Lung	15,324	964	4,095	2,800	1,266	840	714	4,260	385
17: Eyes	13,722	713	4,808	2,054	839	740	442	3,812	314
18: Ears, Nose, and Throat	40,155	4,391	9,444	6,391	3,623	2,328	1,332	11,893	753
19: Urinary System	6,957	252	2,452	1,325	327	375	229	1,810	187
20: Genital System	18,169	219	7,054	3,091	724	963	555	5,121	442
21: Pregnancy-related	4,437	13	1,942	634	168	181	156	1,256	87
22: Skin and Subcutaneous	23,478	1,361	7,812	3,298	1,620	1,304	838	6,745	500
23: Injury, Poisoning, Complications	24,119	1,862	6,584	3,767	1,880	1,368	893	7,173	592
24: Symptoms, Signs and Ill-Defined Cond	42,804	2,134	14,539	6,580	2,616	2,390	1,423	11,859	1,263
25: Pediatric and Congenital Disorders	3,049	381	933	399	246	123	75	843	49
26: Neonates	1,955	304	517	247	145	74	45	596	27
27: Transplants, Openings, Other V-Codes	3,388	165	968	598	144	270	124	953	166
28: Screening/History	75,056	7,857	21,796	9,657	5,801	3,621	1,669	23,615	1,040
29: Life Sustaining Procedure Based	0	0	0	0	0	0	0	0	0
30: Principal Inpatient Diagnosis Based	421	10	128	48	33	27	22	138	15

Since the purpose of these profiles is to provide an efficiency comparison, efficiency indices by risk unit will be very helpful for hospital administrators:

Table 2.4: Actual & Predicted Expenditures and Efficiency Indices by Risk Unit -Weighted by Eligible Months

-	Total	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8
Number of Eligible Years	146,832	10,115	46,181	24,170	8,747	7,274	4,763	42,471	3,112
Actual Expenditures									
Concurrent (Year 1) 1998	$887	$469	$1,072	$724	$834	$992	$916	$844	$1,223
Actual Expenditure Scores	**(Normalized to Sample Mean)**								
Concurrent (Year 1) 1998	1.00	0.53	1.21	0.82	0.94	1.12	1.03	0.95	1.38
Relative Risk Scores	**(Normalized to Sample Mean)**								
Age/Sex Model	1.00	0.33	1.19	1.02	0.77	1.02	1.03	0.97	1.19
Concurrent Model (Year 1)	1.00	0.59	1.18	0.95	0.86	1.10	1.06	0.91	1.37
Prospective Model (Year 2)	1.00	0.33	1.26	0.98	0.72	1.04	1.07	0.91	1.25
Risk Adjusted Expenditures	**(Actual Expenditures Divided by Relative Risk Scores)**								
Age/Sex Model	$887	$1,421	$900	$710	$1,084	$973	$889	$870	$1,028
Concurrent Model (Year 1)	$887	$795	$908	$763	$970	$902	$864	$927	$893
Predicted Expenditures	**(Relative Risk Scores * Sample Mean)**								
Age/Sex Model	$887	$293	$1,056	$905	$683	$905	$914	$860	$1,056
Concurrent Model (Year 1)	$887	$523	$1,047	$843	$763	$976	$940	$807	$1,215
Prospective Model (Year 2)	$1,593	$526	$2,007	$1,561	$1,147	$1,657	$1,705	$1,450	$1,991
Efficiency Index	**(Actual Expenditures Divided by Predicted Expenditures)**								
Age/Sex Model	1.00	1.60	1.01	0.80	1.22	1.10	1.00	0.98	1.16
Concurrent Model (Year 1)	1.00	0.90	1.02	0.86	1.09	1.02	0.97	1.05	1.01

The above table first shows the actual expenditure by risk units, then demonstrates the actual expenditure scores, which are each risk unit's actual expenditure divided by the CareGroup sample mean. The actual expenditure scores show the relative risk of each unit to the whole organization's average, which is regardless of the patient population's severity of sickness. The next row in the above table shows the relative risk score, which reflect the patient population's severity of sickness by risk units. The following row is the risk-adjusted expenditure, which is the actual expenditure divided by relative risk score. The following row is the predicted expenditure, which is the relative risk scores times the

CareGroup sample mean. These expenditures demonstrate the amount of money that should spent on a certain patient population taking its sickness into consideration. In the last row is the key point: the efficiency index, which is actual expenditures divided by predicted expenditures. The CareGroup sample mean is the benchmark, which is 1. Those who are less efficient are higher than 1; the lower the score, the more efficient the risk unit is.

After we know how efficient each risk unit is, we would also like to know the distribution of the patient population's aggregated diagnostic cost group.

Table 2.5: Distribution by Aggregated DCG (ADCG)

Concurrent DCG3 Model, Predicting 1998

	Benchmark		Current Sample			
	People	Dollars	People		Dollars	
ADCG Expenditure Range	Percent	Percent	Number	Percent	Mean	Percent
Total	100.0	100.0	195,776	100.0	$1,656	100.0
$0 to $999	76.0	12.8	136,408	69.7	$306	12.9
$1000 to 4999	17.3	27.0	45,112	23.0	$2,247	31.3
$5000 to 9999	4.1	19.3	8,804	4.5	$6,820	18.5
$10,000 to 24,999	2.0	21.0	4,233	2.2	$15,274	19.9
$25,000 or more	0.7	19.9	1,219	0.6	$46,328	17.4

Table 2.5 shows most of the patients (93%) have spending falling into the category between no cost and less than $10,000. Less than 7% of the patients have cost of $10,000 or more. This can serve the purpose of case management which can capture those 5% of patients who spend 95% of the spending and provide better preventive care for these patients to save some spending so that can better serve other 95% patients.

If we want to look at more detailed spending, the next table can serve this purpose:

Table 2.6: Distribution by DCG Concurrent DCG3 Model, Predicting 1998

	Benchmark		Current Sample			
	People	Dollars	People		Dollars	
DCG Expenditure Range	Percent	Percent	Number	Percent	Mean	Percent
Total	100.0	100.0	195,776	100.0	$1,656	100.0
$0 to $99	0.0	0.0	0	0.0	$0	0.0
$100 to 199	57.2	5.9	82,472	42.1	$152	3.9
$200 to 299	2.3	0.4	6,664	3.4	$236	0.5
$300 to 399	5.2	1.2	13,090	6.7	$344	1.4
$400 to 499	2.0	0.6	8,127	4.2	$468	1.2
$500 to 699	4.1	1.7	11,653	6.0	$604	2.2
$700 to 999	5.2	3.1	14,402	7.4	$853	3.8
$1000 to 1499	5.0	4.3	13,827	7.1	$1,245	5.3
$1500 to 1999	3.8	4.5	10,455	5.3	$1,747	5.6
$2000 to 2499	2.6	3.9	6,707	3.4	$2,253	4.7
$2500 to 2999	1.7	3.3	4,255	2.2	$2,769	3.6
$3000 to 3999	2.5	5.9	5,705	2.9	$3,539	6.2
$4000 to 4999	1.7	5.1	4,163	2.1	$4,512	5.8
$5000 to 5999	1.3	5.0	3,427	1.8	$5,515	5.8
$6000 to 7499	1.4	6.5	2,935	1.5	$6,775	6.1
$7500 to 9999	1.3	7.8	2,442	1.3	$8,704	6.6
$10,000 to 14,999	1.2	9.9	2,453	1.3	$12,595	9.5
$15,000 to 19,999	0.6	6.6	1,216	0.6	$17,358	6.5
$20,000 to 24,999	0.3	4.5	564	0.3	$22,435	3.9
$25,000 to 29,999	0.2	3.4	339	0.2	$27,671	2.9
$30,000 to 39,999	0.2	4.7	386	0.2	$34,523	4.1
$40,000 to 49,999	0.1	3.3	205	0.1	$44,895	2.8
$50,000 to 59,999	0.1	2.2	108	0.1	$55,457	1.9
$60,000 to 69,999	0.0	1.7	50	0.0	$65,847	1.0
$70,000 +	0.1	4.7	131	0.1	$116,658	4.7

In order to determine the distributed among each risk unit within CareGroup, the following tables show the percentage distribution of the aggregated diagnostic cost group:

Table 2.7: Percentage Distribution of Aggregated DCG (ADCG)

	Bench mark	Current Sample----								
ADCG Expenditure Range	**Percent**	**Total**	**RU1**	**RU2**	**RU3**	**RU4**	**RU5**	**RU6**	**RU7**	**RU8**
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
$0 to $999	76.0	69.7	82.9	65.1	71.3	71.8	67.1	67.4	71.7	58.0
$1000 to 4999	17.3	23.0	13.7	25.9	22.0	22.3	24.4	24.2	22.0	31.2
$5000 to 9999	4.1	4.5	2.1	5.4	4.2	3.7	5.4	5.4	4.0	6.8
$10,000 to 24,999	2.0	2.2	1.0	2.8	1.8	1.7	2.3	2.5	1.9	3.2
$25,000 or more	0.7	0.6	0.3	0.8	0.6	0.5	0.7	0.5	0.6	0.8

All the previous tables show the profile for the current year, but how about our next year's patient population? Can we predict their spending according to their chronicled conditions? The following tables tell us the story:

Table 2.8: Distribution by Aggregated DCG (ADCG)

Prospective DCG3 Model, Predicting 1999

	Benchmark		Current Sample			
	People	**Dollars**	**People**		**Dollars**	
ADCG Expenditure Range	Percent	Percent	Number	Percent	Mean	Percent
Total	100.0	100.0	195,776	100.0	$1,765	100.0
$0 to $999	48.4	14.6	82,559	42.2	$490	11.7
$1000 to 4999	46.6	54.0	101,247	51.7	$1,852	54.3
$5000 to 9999	3.7	15.6	8,796	4.5	$6,554	16.7
$10,000 to 24,999	1.0	9.6	2,615	1.3	$15,593	11.8
$25,000 or more	0.3	6.2	559	0.3	$34,270	5.5

Table 2.8 shows the number of people in each expenditure category given their chronic condition. Other unpredicted injuries and disease will not be taken into consideration.

Table 2.9: Distribution by DCG

Prospective DCG3 Model, Predicting 1999

	Benchmark		Current Sample			
	People	Dollars	People		Dollars	
DCG Expenditure Range	Percent	Percent	Number	Percent	Mean	Percent
Total	100.0	100.0	195,776	100.0	$1,765	100.0
$0 to $99	0.0	0.0	0	0.0	$0	0.0
$100 to 199	0.0	0.0	0	0.0	$0	0.0
$200 to 299	13.1	2.2	21,204	10.8	$267	1.6
$300 to 399	8.1	1.8	12,549	6.4	$339	1.2
$400 to 499	8.0	2.4	9,792	5.0	$472	1.3
$500 to 699	11.4	4.3	23,062	11.8	$586	3.9
$700 to 999	7.8	3.9	15,952	8.2	$779	3.6
$1000 to 1499	27.4	21.3	58,217	29.7	$1,216	20.5
$1500 to 1999	4.8	5.3	9,847	5.0	$1,730	4.9
$2000 to 2499	5.6	7.7	11,599	5.9	$2,149	7.2
$2500 to 2999	2.2	3.8	6,230	3.2	$2,693	4.9
$3000 to 3999	3.8	8.3	9,735	5.0	$3,387	9.5
$4000 to 4999	2.7	7.6	5,619	2.9	$4,444	7.2
$5000 to 5999	1.6	5.6	3,909	2.0	$5,368	6.1
$6000 to 7499	1.2	5.1	2,776	1.4	$6,673	5.4
$7500 to 9999	0.9	4.9	2,111	1.1	$8,595	5.3
$10,000 to 14,999	0.6	4.8	1,498	0.8	$11,997	5.2
$15,000 to 19,999	0.2	2.4	497	0.3	$17,160	2.5
$20,000 to 24,999	0.2	2.4	620	0.3	$23,024	4.1
$25,000 to 29,999	0.1	1.9	258	0.1	$27,059	2.0
$30,000 to 39,999	0.1	2.0	191	0.1	$33,895	1.9
$40,000 to 49,999	0.0	1.1	66	0.0	$44,011	0.8
$50,000 to 59,999	0.0	0.6	22	0.0	$53,854	0.3
$60,000 to 69,999	0.0	0.3	13	0.0	$63,515	0.2
$70,000 +	0.0	0.3	9	0.0	$87,387	0.2

As did Table 2.8, Table 2.9 gives us a more detailed picture for our patient population's 1999 spending by diagnostic cost group according to their chronic conditions. Again other unpredicted injuries and disease will not be take into consideration.

Table 2.10: Percentage Distribution of Aggregated DCG (ADCG) By Risk Unit Prospective DCG3 Model, Predicting 1999

	Benchmark		Current Sample							
ADCG Expenditure Range	%	Total	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8
Total	100	100	100	100	100	100	100	100	100	100
$0 to $999	48.4	42.2	91.2	27.5	41.9	58.3	41.8	42.9	44.3	28.1
$1000 to 4999	46.6	51.7	7.5	64.1	52.4	38.0	51.5	49.6	50.6	63.3
$5000 to 9999	3.7	4.5	0.9	5.9	4.3	2.7	4.9	5.9	3.9	6.4
$10,000 to 24,999	1.0	1.3	0.4	2.0	1.2	0.8	1.5	1.4	1.0	1.9
$25,000 or more	0.3	0.3	0.0	0.4	0.2	0.1	0.3	0.2	0.2	0.3

Table 2.10 shows the CareGroup 8 hospital's patient population's spending distribution. This table can help the hospital administrators to set a rough budget for 1999 according to the chronic conditions of their current populations without taking into new patients and unpredicted disease and injuries into consideration.

Re-calibration by Service Category

Since CareGroup would also want to evaluate how much a new normalization affects things, and make a decision about whether to use the single relative cost factor (PRED31c) or use recalibrated ones, the intent was to focus on simple adjustments, and use perhaps only a linear model.

After some thought, I found out that it is much better to use the DCG categorical variables for recalibration instead of doing the linear model a + b*pred31c that was initially prepared. The reason is that the linear model will most likely make negative predictions for lots of people, and this is a big problem if it is to be used in a denominator

for normalizing. So we decided to use a Generalized Linear Model, with DCG31c as a class variable. Our databases have enough observations to do this.

This normalization works well only if the risk score is not too close to zero to create a normalized value of the variable being predicted for each person. So instead of normalizing each person alone, we normalize it for groups. Hence for each doctor or practice groups or hospitals are as follows:

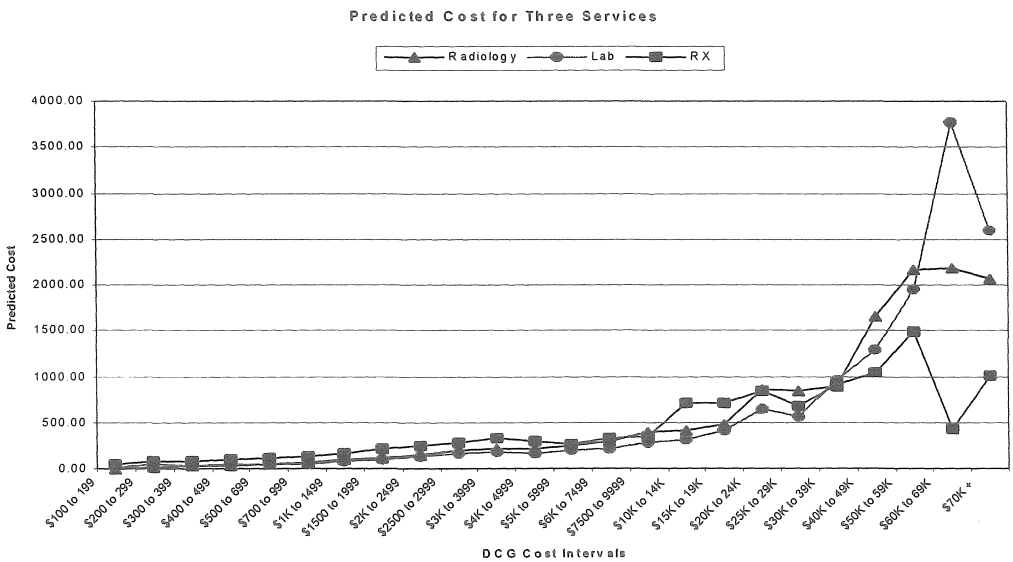
Adjusted average spending = (sum of actual costs)/(sum of normalized risk scores)

This will be better than using

Average adjusted spending = sum of (actual costs/(normalized risk score))

The first variable is much more stable with respect to outliers. The following figure shows us the recalibrated predicted result for service categories by cost groups which proves how well the single model performs:

Figure 2.2 Predicated cost estimate by recaliberating category:



After running the recalibration program based on the data we have, the model fits the three services well. The coefficients were generally monotonic, and did well over most of the DCGs with the exception of the very highest values where there just are not enough people to predict spending reliably. It would be also helpful to know how well the model also does in predicting the total spending, not just the three components, since this provides a nice benchmark.

There are some pros and cons for this recalibrations. The pros are: The main thing that this recalibration buys us is a better fit at the tails, reflecting better the nonlinear pattern of low costs for most, and very high predicted costs for a few. Possibly this impresses our clinicians. The second argument in favor is that the model might do better on smaller panel sizes. The comparisons that I have done so far are for panels with several thousand patients. The nonlinearities would not be expected to affect the means when averages of this size are computed. The third argument in favor is that doctors seeing the method might PREFER a more complicated to a simpler model since it may have more clinical credibility. The complicated model will provide more targeted predictions toward certain service categories, which is comparing apples to apples.

The cons are that the recalibrated models are rather complicated and tedious and it does not seem credible that all costs simply grow in the same proportion.

However, since the recalibrated models have proved that the single model performs very well in predicting for each specific category, for simplifying purposes, we decided to use the single model score as the multiplier.

Concl sions fro the Case St d

A variety of methodological issues are raised when developing or interpreting provider profiles that compare patient outcomes. In most instances, conclusions must be drawn tentatively due to small sample sizes and the difficulty of adjusting adequately for patient risk. Despite these challenges, however, profiles are increasingly generated around the country and are used as an important tool in ensuring healthcare "value" --a melding of cost and quality.

We believe that comparing patient outcomes across providers is valuable, but much depends on how the profiles are used. Given the state of the art, it is inappropriate to use such profiles alone to make "all or nothing" business decisions: for example, telling an "outliner" provider that unless their profile rating improves, business will be withdrawn. In this context, profiles are likely to generate criticism --often based on well-founded methodological concerns-- and heighten adversarial relationships among providers, payers, and policymakers. Similarly, if such profiles are disseminated to a public unaware of the need to draw conclusions tentatively, further controversy will likely follow, impeding opportunities for productive dialogue and improvements. If profiles are

released to providers without appropriate education about how to use them to identify areas for improvement, they are likely to be ignored.

Profiles comparing patient outcomes are most valuable in an environment of cooperation and collaboration, with incentives for learning and improvement.

III. Conclusion

Many projects I was involved in involving data mining and modeling are like most of the initial programs to compare provider performance focused on hospitalizations, examining mortality, Length of Stay, and charges. While these are clearly important outcomes, they are fairly limited, especially from many consumers' perspectives--death is not an immediate prospect for most persons, and the public may be more interested in functional outcomes or quality of life. In addition, most persons, particularly those of working age, are not hospitalized during a given year. Outcomes relating to outpatient and preventive services are therefore more applicable to their concerns. Especially as managed care increasingly constricts the reimbursable services available to consumers, the burden of proof about quality shifts somewhat from the provider alone to encompass the health plan as well. This is the reason I choose to talk about Physician profiles with Risk Adjustment from the patients' claims diagnosis files. This kind of study will be very helpful to hospital executives, payers and working-class patients. The social and economic value of these kinds of studies should never be underestimated.

There are many limitations for such studies, such as different views of stakeholders, concerns about the risk-adjustment methodology, incomplete data, small sample size, limited study length, confidentiality issues, side effects, etc.

In this study, one of the most troubling consequences of publishing the report cards--especially by individual doctor --is the possibility that providers will avoid high-risk patients. These patients are, by definition, more likely to suffer bad outcomes, thereby potentially decreasing their provider's performance. Thus, besides doing these profiles, methods must be figured out to encourage doctors to accept sicker patients and at the same time to provide more efficient and effective care to all the patients. This is a question to all healthcare economics researchers, hospital administrators, stakeholders, payers as well as the providers and patients themselves.

IV. Policy Implications

Change in our healthcare system is increasingly fragmented into diverse regional marketplaces. Locally, competition is fierce among health plans and providers, with constant jockeying measurement efforts, including comparisons of outcomes using various risk-adjustment methodologies. A bewildering array of reports is produced, even in neighboring cities. For example, in the case study of this paper, we use the DxCG methodology, which has been used by HCFA (Health Care Financial Administration). In Ohio alone, Cleveland uses its own, home-grown risk adjustment (developed by Michael Pine & Associates); Cincinnati uses Iameter's AIM; and the Dayton employer coalition chose MedStat's Disease Staging .[5]

Without common methods, comparisons are meaningless. Calls are therefore increasing for national standards to enhance the consistency of quality measures and permit comparisons across regions. As a representative of a midsize manufacturing firm asserted, " The government should prescribe some standards and force providers to adhere to these standards in the publishing of information. The government should say, 'You're going to code this disease this way, and you do it consistently and uniformly'".[6]

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[5] Verna, G. 1996. "Dayton Hospitals Link to Perform Cost Study." *Cincinnati Business Courier* 13(4):8C.
[6] United States General Accounting Office; Health, Education, and Human Services Division (USGAO), 1995. *Employers and Individual Consumers Want Additional Information on Quality.* (GAO/HEHS-95-201) Washington, D.C.

Nonetheless, experience suggests that local stakeholders in different marketplaces do differ in their interests and emphasis. Achieving a balance between standardizing measures to facilitate widespread comparisons and customizing measures to address local needs the current challenge.

However, even in regions with longer experience in this endeavor, two questions remain unanswered: what do risk-adjusted outcomes (mostly mortality rates) mean about the quality of care; and what is the aggregate effect of these initiatives on total healthcare costs? As the GAO observed, the staples of most hospital reports (mortality and length of stay) " are considered too narrow to truly reflect quality".[7] "Some of the cost savings employers attribute to efficiency improvements in inpatient hospital care are partially offset by higher expenditures for ambulatory care".[8] This situation has not stopped purchasers from using report-card findings. Nonetheless, it heightens concerns about balancing reservations about the actual implications of most risk-adjusted outcome information. Harvard Medical School Professor Dr. Lisa Iezzoni suggests several factors that must be addressed: "First, the participants in this activity should understand that they are jointly entering a large, applied experiment. In an experiment --as opposed to an endeavor using well accepted, rigorous methods with clearly understood benefits-- evaluation is critical. If providers and business coalitions jointly recognize the

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[7] United States General Accounting Office; Health, Education, and Human Services Division (USGAO), 1994. *Employers Urge Hospitals to Battle Costs Using Performance Data Systems.* (GAO/HEHS-95-1) Washington, D.C. (p12).

[8] United States General Accounting Office; Health, Education, and Human Services Division (USGAO), 1994. *Employers Urge Hospitals to Battle Costs Using Performance Data Systems.*. (GAO/HEHS-95-1) Washington, D.C. (p9).

experimental nature of their undertaking, tensions between the two groups may lessen. It also would allow them to unify around the common objective of learning the value of severity-derived data for interpreting hospital cost and quality figures.

Second, the participants in the discourse about severity-derived information must understand better the goals and concerns of the other sides. Providers could learn more about the desire of local businesses to quantify hospital quality, permitting more prudent, better-informed decisions--purchasers reasonably no longer accept vague promises about quality monitoring, without concrete evidence of its results. In turn, business leaders could explore the legitimate reservations of providers about the limitations of severity data and the outcomes that are being studied Providers need to be intimately involved in selecting the risk adjusters, to ensure--at a minimum -- face validity. By working in concert, the common goal of improving quality and efficiency may be achieved.

Third, given the uncertainty surrounding interpretation of much of these data, it is important to weigh what actions may reasonably be founded on the information.

Fourth, in times of increasingly constrained resources, concerns about costs and trade-off inevitably arise.

Finally, the Institute of Medicine observed: 'The public interest is materially served when society is given as much information on costs, quality, and value for healthcare dollar

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expended as can be given accurately and provided with educational materials that aid interpretation of the at information. Public disclosure is acceptable only when it: (1) involves information and analytic results that come from studies that have been well conducted, (2) is based on data that can be shown to be reliable and valid for the purposes intended, and (3) is accompanied by appropriate educational material.'"[9]

Thus, to provide efficient and effective care of people and the study of it will be a long-term task for all of us.

[9] Donaldson, M.S., and K.N.Lohr. 1994, *Health Data in the Information Age. Use, Disclosure, and Privacy*. Washington, D.C.: National Academy Press.

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7. March 1998 report to the President, the Advisory Commission on Consumer Protection and Quality in the Health Care Industry, http://www.hcqualitycommission.gov/final/chap04.html

8. United States General Accounting Office; Health, Education, and Human Services Division (USGAO), 1994. "Employers Urge Hospitals to Battle Costs Using Performance Data Systems." (GAO/HEHS-95-1) Washington, D.C.

9. United States General Accounting Office; Health, Education, and Human Services Division (USGAO), 1995. "Employers and Individual Consumers Want Additional Information on Quality". (GAO/HEHS-95-201) Washington, D.C.

10. Verna, G. 1996. "Dayton Hospitals Link to Perform Cost Study." *Cincinnati Business Courier* 13(4):8C.

VI. Appendix:

Sample SAS programs and outputs;